Appendix H

Using Kitchen Thermometers

One of the critical factors in controlling pathogens in food is controlling temperature. Disease-causing microorganisms such as bacteria, viruses, and parasites grow very slowly at low temperatures, multiply rapidly in mid-range temperatures, and are killed at high temperatures. For safety, perishable foods must be held at proper cold temperatures to inhibit bacterial growth or cooked to temperatures high enough to kill harmful microorganisms. It is essential to use a food thermometer when cooking meat, poultry, and egg products to prevent undercooking, and consequently, prevent foodborne illness.

Why Use a Food Thermometer?

Using a food thermometer is the only reliable way to ensure safety and to determine the "doneness" of meat, poultry, and egg products. To be safe, these foods must be cooked to an internal temperature high enough to destroy any harmful microorganisms that may be in the food.

"Doneness" refers to when a food is cooked to a desired state and indicates the sensory aspects of foods such as texture, appearance, and juiciness. Unlike the temperatures required for safety, these sensory aspects are subjective.

Types of Thermometers

Food thermometers come in several types and styles, and vary in level of technology and price.

Digital Food Thermometers

Thermocouple:

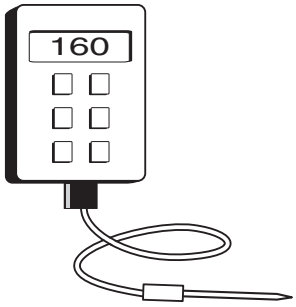
Of all food thermometers, thermocouple thermometers reach and display the final temperature the fastest–within two to five seconds. The temperature is indicated on a digital display.

A thermocouple measures temperature at the junction of two fine wires located in the tip of the probe. Thermocouples used in scientific laboratories have very thin probes, similar to hypodermic needles, while others may have a thickness of $^{1}/_{16}$ of an inch.

Since thermocouple thermometers respond so rapidly, the temperature can be quickly checked in a number of locations to ensure that the food is thoroughly cooked. This is especially useful for testing large food items, such as roasts or turkeys, when checking the temperature in more than one place is advised. The thin probe of the thermocouple also enables it to accurately read the temperature of thin foods, such as hamburger patties, pork chops, and chicken breasts.

Thermocouples are not designed to remain in the food while it is cooking. They should be used near the end of the estimated cooking time to check for final cooking temperatures. To prevent overcooking, check the temperature before the food is expected to finish cooking.

Thermocouples can be calibrated for accuracy.



Thermistors:

Thermistor-style food thermometers use a resistor (a ceramic semiconductor bonded in the tip with temperature-sensitive epoxy) to measure temperature. The thickness of the probe is approximately $^{1}/_{8}$ of an inch and takes roughly 10 seconds to register the temperature on the digital display. Since the semiconductor is in the tip, thermistors can measure temperature in thin foods, as well as thick foods. Because the center of a food is usually cooler than the outer surface, place the tip in the center of the thickest part of the food.

Thermistors are not designed to remain in the food while it is cooking. They should be used near the end of the estimated cooking time to check for final cooking temperatures. To prevent overcooking, check the temperature before the food is expected to finish cooking.

Not all thermistors can be calibrated. Check the manufacturer's instructions.

Dial Food Thermometers

Bimetallic-coil Thermometers:

The probes of these thermometers contain a coil made of two different metals that are bonded together. The two metals have different rates of expansion. The coil, which is connected to the temperature indicator, expands when heated. This food thermometer senses temperature from its tip and up the stem for 2 to 2 1/ 2 inches. The resulting temperature is an average of the temperatures along the sensing area. These food thermometers have a dial display and are available as "oven-safe" and "instant-read."

"Oven-safe" Bimetallic-coil Thermometers: This food thermometer is designed to remain in the food while it is cooking in the oven, and is generally used for large items, such as a roast or turkey. This

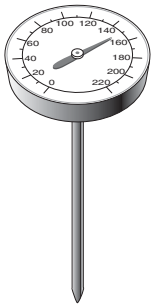
food thermometer is convenient because it constantly shows the temperature of the food while it is cooking. However, if not left in the food while cooking, it can take as long as one to two minutes to register the correct temperature.

The bimetal food thermometer can accurately measure the temperature of relatively thick foods (such as beef roasts) or deep foods (foods in a stockpot). Because the temperature-sensing coil on the stem is between 2 to 2 $^1/_2$ inches long and the stem is relatively thick, it is not appropriate to measure the temperature of any food less than 3 inches thick.

There is concern that because heat conducts along the stem's metal surface faster than through the food, the area of the food in contact with the thermometer tip will be hotter than the area a short distance to the side (the "potato nail effect").

To remedy this, the temperature should be taken in a second, and even third area, to verify the temperature of the food. Each time the thermometer is inserted into the food, let the thermometer equilibrate (come to temperature) at least one minute before reading the temperature.

Some models can be calibrated. Check the manufacturer's instructions.



"Instant Read" Bimetallic-coil Thermometers: This food thermometer quickly measures the temperature of a food in about 15 to 20 seconds. It is not designed to remain in the food while it is cooking in the oven, but should be used near the end of the estimated cooking time to check for final cooking temperatures. To prevent overcooking, check the temperature before the food is expected to finish cooking.

For accurate temperature measurement, the probe of the bimetallic-coil thermometer must be inserted the full length of the sensing area (usually 2 to 3 inches). If measuring the temperature of a thin food, such as a hamburger pattie or boneless chicken breast, the probe should be inserted through the side of the food so that the entire sensing area is positioned through the center of the food. Some models can be calibrated. Check the manufacturer's instructions.

Using the Food Thermometer

Most available food thermometers will give an accurate reading within 2 to 4 °F. The reading will only be correct, however, if the thermometer is placed in the proper location in the food. If not inserted correctly, or if the food thermometer is placed in the wrong area, the reading will not accurately reflect the internal temperature of the food. In general, the food thermometer should be placed in the thickest part of the food, away from bone, fat, or gristle.

Check Manufacturer's Instructions

Before using a food thermometer, read the manufacturer's instructions. The instructions should tell how far the thermometer must be inserted in a food to give an accurate reading. If instructions are not available, check the stem of the food thermometer for an indentation, or "dimple." This shows one end of the location of the sensing device. Dial thermometers must penetrate about 2 to 3 inches into the food. Most digital thermometers will read the temperature in a small area of the tip.

Where to Place the Food Thermometer

Meat

When taking the temperature of beef, pork, or lamb roasts, the food thermometer should be placed midway in the roast, avoiding the bone. When cooking hamburgers, steaks, or chops, insert a thermistor or thermocouple in the thickest part, away from bone, fat, or gristle. If using a dial bimetal thermometer, read "Thin Foods" below.

When the food being cooked is irregularly shaped, such as with a beef roast, check the temperature in several places.

Poultry

When cooking whole poultry, the food thermometer should be inserted into the thickest part of the thigh (avoiding the bone). If cooking poultry parts, insert food thermometer into the thickest area, avoiding the bone. The food thermometer may be inserted sideways if necessary. When the food is irregularly shaped, the temperature should be checked in several places.

Thin Foods

When measuring the temperature of a thin food, such as a hamburger pattie, pork chop, or chicken breast, a thermistor or thermocouple food thermometer should be used, if possible.

However, if using an "instant-read" dial bimetallic-coil food thermometer, the probe must be inserted in the side of the food so that entire sensing area (usually 2-3 inches) is positioned through the center of the food.

To avoid burning fingers, it may be helpful to remove the food from the heat source (if cooking on a grill or in a frying pan) and insert the food thermometer sideways after placing the item on a clean spatula or plate.

Combination Dishes

For casseroles and other combination dishes, place the food thermometer into the thickest portion of the food or the center of the dish. Egg dishes and dishes containing ground meat and poultry should be checked in several places.

Thermometer Care

As with any cooking utensil, food thermometers should be washed with hot, soapy water. Most thermometers should not be immersed in water. Wash carefully by hand.

Use caution when using a food thermometer. Some models have plastic faces, which can melt if placed too close to heat or dropped in hot liquid.

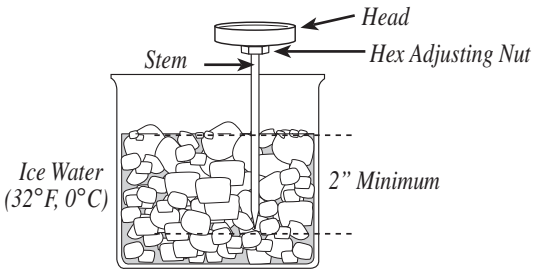
Thermometer probes are sharp and should be stored with the probe in the stem sheath. Some glass thermometers are sensitive to rough handling and should be stored in their packaging for extra protection or in a location where they will not be jostled.

Calibrating a Thermometer

There are two ways to check the accuracy of a food thermometer. One method uses ice water, the other uses boiling water. Many food thermometers have a calibration nut under the dial that can be adjusted. Check the package for instructions.

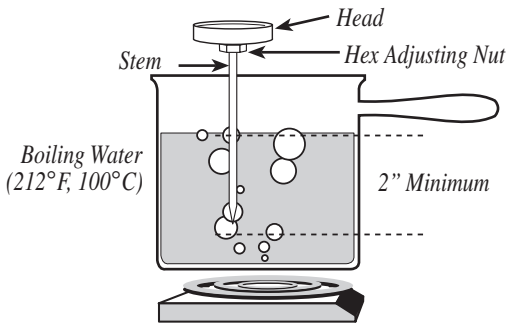
Ice Water

To use the ice water method, fill a large glass with finely crushed ice. Add clean tap water to the top of the ice and stir well. Immerse the food thermometer stem a minimum of 2 inches into the mixture, touching neither the sides nor the bottom of the glass. Wait a minimum of 30 seconds before adjusting. (For ease in handling, the stem of the food thermometer can be placed through the clip section of the stem sheath and, holding the sheath horizontally, lowered into the water.) Without removing the stem from the ice, hold the adjusting nut under the head of the thermometer with a suitable tool and turn the head so the pointer reads 32°F.



Boiling Water

To use the boiling water method, bring a pot of clean tap water to a full, rolling boil. Immerse the stem of a food thermometer in boiling water a minimum of 2 inches and wait at least 30 seconds. (For ease in handling, the stem of the food thermometer can be placed through the clip section of the stem sheath and, holding the sheath horizontally, lowered into the boiling water.) Without removing the stem from the pan, hold the adjusting nut under the head of the food thermometer with a suitable tool and turn the head so thermometer reads 212°F.



For true accuracy, distilled water must be used and the atmospheric pressure must be one atmosphere (29.921 inches of mercury). Tap water in unknown atmospheric conditions would probably not measure water boiling at 212°F. Most likely it would boil at least 2°F, and perhaps as much as 5°F, lower. Remember that water boils at a lower temperature in a high altitude area.

Even if the food thermometer cannot be calibrated, it should still be checked for accuracy using either method. Any inaccuracies can be taken into consideration when using the food thermometer, or the food thermometer can be replaced. For example, water boils at 212°F. If the food thermometer reads 214°F in boiling water, it is reading 2 degrees too high. Therefore 2 degrees must be subtracted from the temperature displayed when taking a reading in food to find out the true temperature. In another example, for safety, ground beef patties must reach 160°F. If the thermometer is reading 2 degrees too high, 2 degrees would be added to the desired temperature, meaning hamburger patties must be cooked to 162°F.

Information adapted from Kitchen Thermometers, FSIS, USDA, 2000.